APTD-0829

PB 207 697

RENO AREA
AIR POLLUTANT EMISSION INVENTORY

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Environmental Health Service

Reproduced by
NATIONAL TECHNICAL
INFORMATION SERVICE
Springfield, Va. 22151

48
R

BIBLIOGRAPHIC DATA SHEET	1. Report No. APTD-0829	2.	3. Recipient's Accession No.
4. Title and Subtitle Reno Area Air Pollutant Emission Inventory			5. Report Date August 1970 6.
7. Author(s) Michael J. McGraw			8. Performing Organization Rept. No.
9. Performing Organization Name and Address U. S. Department of Health, Education, and Welfare National Air Pollution Control Administration Division of Air Quality and Emission Data Durham, North Carolina			10. Project/Task/Work Unit No. 11. Contract/Grant No.
12. Sponsoring Organization Name and Address Same			13. Type of Report & Period Covered 14.

15. Supplementary Notes

16. Abstracts

A summary of the emission inventory for the Reno, Nevada Metropolitan Area is presented. The pollutants which include sulfur oxides, particulates, carbon monoxide, hydrocarbons, and nitrogen oxides are delineated with respect to source type, season of the year, and geographical distribution within the area. The Study Area consists of five counties surrounding Reno and Carson City. All sources of emissions were classified into five categories: transportation, stationary fuel combustion, solid-waste disposal, industrial processes and evaporative losses.

17. Key Words and Document Analysis. 17a. Descriptors

Air pollution
Emission
Inventories
Sulfur oxides
Particles
Carbon monoxide
Hydrocarbons
Nitrogen oxides
Seasonal variations
Sources
Transportation
Waste disposal
Fuels
Industrial plants
Evaporation

17b. Identifiers/Open-Ended Terms

Particulates
Reno, Nevada
Carson City, Nevada
Nevada

17c. COSATI Field/Group 13B

18. Availability Statement	19. Security Class (This Report)	21. No. of Pages
Unlimited	UNCLASSIFIED	46
	20. Security Class (This Page) UNCLASSIFIED	22. Price

RENO METROPOLITAN AREA AIR POLLUTANT EMISSION INVENTORY

Prepared by
Michael J. McGraw

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
Environmental Health Service
National Air Pollution Control Administration
Division of Air Quality and Emission Data
Durham, North Carolina
August 1970

ACKNOWLEDGMENTS

Sincere gratitude is extended by the National Air Pollution Control Administration to the many individuals and companies who contributed to this study.

Special thanks are due to Burt Cole and James Williams of the State of Nevada Department of Health and Howard Clodfelter of the Washoe County Health Department, who contributed invaluable assistance in the gathering of data for this report.

PREFACE

This report, which presents the emission inventory for the Reno Metropolitan Area, is another in a series of surveys outlining the sources and emissions of air pollutants for major metropolitan areas in the country. These surveys, conducted by the National Inventory of Air Pollutant Emissions and Control Branch of the National Air Pollution Control Administration, provide estimates of the present levels of air pollutant emissions and status of their control. The pollutants which include sulfur oxides, particulates, carbon monoxide, hydrocarbons and nitrogen oxides, are delineated with respect to source type, season of the year and geographical distribution within the area. The general procedure for the surveys is based upon the rapid survey technique for estimating air pollutant emissions.[1] These reports are intended to serve as aids in the proposing of boundaries of Air Quality Control Regions, as directed by the Air Quality Act of 1967.

TABLE OF CONTENTS

	Page
Introduction	1
Summary of Results	3
Study Area	8
Grid Coordinate System	11
Emissions by Category	13
Stationary Fuel Combustion	13
Transportation	13
Motor Vehicles	13
Aircraft	16
Railroads	16
Solid Waste Disposal	16
Industrial Process Losses	22
Evaporative Losses	22
Automobiles	22
Gasoline Storage and Handling	22
Emissions by Jurisdiction	26
Emissions by Grid	32
References	37
Appendices	38

LIST OF TABLES

Table		Page
1	Summary of Air Pollutant Emissions in Study Area.	5
1A	Summary of Air Pollutant Emissions in Study Area.	6
2	Area and Population Characteristics	7
3	Fuel Consumption in Study Area.	14
4	Summary of Emission from Stationary Fuel Combustion Sources	15
5	Vehicle Miles of Travel for Motor Vehicles in Study Area. . . .	17
6	Air Pollutant Emissions from Transportation Sources	18
7	Airport Activity at Major Airport in Study Area	19
8	Solid Waste Balance for Reno Study Area	20
9	Air Pollutant Emissions from Solid Waste Disposal	21
10	Particulate Emissions from Industrial Processes	23
11	Hydrocarbon Emissions from Evaporative Loss Sources	24
12	Summary of Air Pollutant Emissions in Carson City	27
13	Summary of Air Pollutant Emissions in Douglas County.	28
14	Summary of Air Pollutant Emissions in Lyon County	29
15	Summary of Air Pollutant Emissions in Storey County	30
16	Summary of Air Pollutant Emissions in Washoe County	31
17	Summary of Air Pollutant Emissions from Point Sources	33
18	Summary of Air Pollutant Emissions.	34

LIST OF FIGURES

Figure		Page
1	Map of the Reno Study Area.	9
2	Detailed Map of Study Area.	10
3	Grid Coordinate System for Study Area	12

INTRODUCTION

This report is a summary of the Reno air pollutant emission inventory conducted in March 1970. Since all inventories are based upon a calendar year, the data and emission estimates presented are representative of 1969 and should be considered as indicating the conditions as existed during that year.

The Study Area, which was chosen on the basis of the distribution of population and air pollution sources, consists of five counties surrounding Reno and Carson City. This area covers approximately 9,400 square miles and had a 1969 population of 161,500.

A grid coordinate system was used to show the geographical distribution of emissions within counties. The Study Area was subdivided into 60 grid zones ranging in size from 25 square kilometers in the heavily populated and industrialized areas to 400 square kilometers in the rural areas.

All sources of emissions were classified into five categories--transportation, stationary fuel combustion, solid-waste disposal, industrial processes and evaporative losses. Each of these source categories was divided into two subgroups--point and area sources. Facilities, which emit large quantities of air pollutants, were considered individually as point sources, while the many remaining contributors such as motor vehicles, residential and commercial fuel users, small industries and on-site refuse burning equipment, were considered collectively as area sources. For this report, seventy-one individual sources, which had emissions greater than 50 tons/year for any pollutant, were classified as point sources.

Emissions were estimated by using various indicators such as fuel consumption, refuse burning rates, vehicle-miles, production data, and control efficiencies and emission factors relating these indicators to emission rates.[2] These factors represent average emission rates for a particular source category. Since individual sources have inherent differences that cannot always be taken into consideration, discrepancies

between the actual and estimated emissions are more likely in individual sources than in the total emissions for a source category.

As in all emission surveys, the data presented are estimates and should not be interpreted as absolute values. The estimates are, in some cases, partial totals due to the lack of emission factors and production or consumption data. Despite these limitations, these estimates are of sufficient accuracy and validity in defining the extent and distribution of air pollutant emissions in the Study Area.

RESULTS

The breakdown of air pollutant emissions by source type and pollutant is summarized in Table 1 and Table 2. The following is a brief summary of pollutant emissions as presented in these tables.

Sulfur Oxides: 1969 Total = 2,500 Tons

Road Vehicles	22.1%
Other Transportation	1.2%
Fuel Combustion	
Industrial	5.5%
Residential	22.1%
Commercial	47.1%
Solid Waste Disposal	2.0%

Particulates: 1969 Total = 35,500 Tons

Road Vehicles	2.9%
Other Transportation	0.5%
Fuel Combustion	1.0%
Solid Waste Disposal	0.8%
Industrial Process	94.8%

Carbon Monoxide: 1969 Total = 128,500 Tons

Road Vehicles	98.5%
Other Transportation	0.5%
Solid Waste Disposal	
Incineration	0.4%
Open Burning	0.6%

Hydrocarbons: 1969 Total = 17,700 Tons

Road Vehicles	54.8%
Other Transportation	1.9%
Fuel Combustion	0.2%
Solid Waste Disposal	0.6%
Evaporative Losses	42.5%

Nitrogen Oxides:	1969 Total = '0,000 Tons
Road Vehicles	63.1%
Other Transportation	2.6%
Fuel Combustion	
Industrial	2.4%
Steam-Electric	21.7%
Residential	2.4%
Commercial	6.8%
Solid Waste Disposal	1.0%

TABLE 1 SUMMARY OF AIR POLLUTANT EMISSIONS IN STUDY AREA, 1969

(Tons/Year)

Source Category	Sulfur Oxides	Particulates	Carbon Monoxide	Hydrocarbons[b]	Nitrogen Oxides
Transportation					
Road Vehicles	560	1,040	126,500	9,730	6,350
Other	30	170	650	330	260
Subtotal	590	1,210	127,150	10,060	6,610
Stationary Fuel Combustion					
Steam-Electric	N	80	N	N	2,190
Industry	140	30	N	N	240
Residential	560	90	20	30	350
Commercial and Institutional	1,190	160	10	10	680
Subtotal	1,890	360	30	40	3,460
Refuse Disposal					
Incineration	20	120	520	10	40
Open Burning	30	170	770	90	60
Subtotal	50	290	1,290	100	100
Industrial Process	--	33,610	--	--	--
Evaporative Losses	--	--	--	7,540	--
GRAND TOTAL[a]	2,500	35,500	128,500	17,700	10,000

N = Negligible

a = Totals have been rounded.

b = Evaporative losses from motor vehicles included under evaporative losses only.

TABLE 1A SUMMARY OF AIR POLLUTANT EMISSIONS IN STUDY AREA, 1969

(1000 kg/year)

Source Category	Sulfur Oxides	Partic-ulates	Carbon Monoxide	Hydro-carbons	Nitrogen Oxides
Transportation					
Motor Vehicles	510	940	114,700	8,830	5,760
Other	30	150	590	300	240
Subtotal	540	1,090	115,290	9,130	6,000
Stationary Fuel Combustion					
Industrial	130	30	N	N	220
Steam-Electric	N	70	N	N	1,990
Residential	510	80	20	30	220
Commercial and Institutional	1,080	150	10	10	620
Subtotal	1,720	330	30	40	3,050
Refuse Disposal					
Incineration	20	110	470	10	40
Open Burning	30	150	700	80	50
Subtotal	50	260	1,170	90	90
Industrial Processes	--	30,490	--	--	--
Evaporative Losses	--	--	--	6,840	--
GRAND TOTAL	2,310	32,170	116,490	16,100	9,140

TABLE 2 AREA AND POPULATION CHARACTERISTICS FOR THE RENO STUDY AREA

Political Jurisdiction	Land Area (Sq. Mi.)	Population 1960	Population 1969	Population Density (1969)
Carson City	141	8,100	15,400	109
Douglas	2,946	3,500	6,400	2
Lyon	2,010	5,100	8,100	4
Storey	262	570	600	2
Washoe[a]	4,000	84,700	131,000	20
TOTAL	9,359	102,970	161,500	17

a = Includes only a portion of the entire county.

STUDY AREA

The Study Area for the emission survey of the Reno Metropolitan Area consists of five counties surrounding the cities of Reno and Carson City. Since it was felt that the northern half of Washoe County was not tied closely with the area it was not included in this preliminary area. Figure 1 shows the location of the Reno Study Area relative to other large cities in its vicinity.

Figure 2 represents a more detailed drawing of the Reno Study Area showing the major urban areas. It should be pointed out that the boundaries of these areas do not correspond to city limits, but rather give a general outline of the major clusters of population. This Study Area occupies 9,400 square miles and contained an estimated 1969 population of 161,500 (see Table 2).

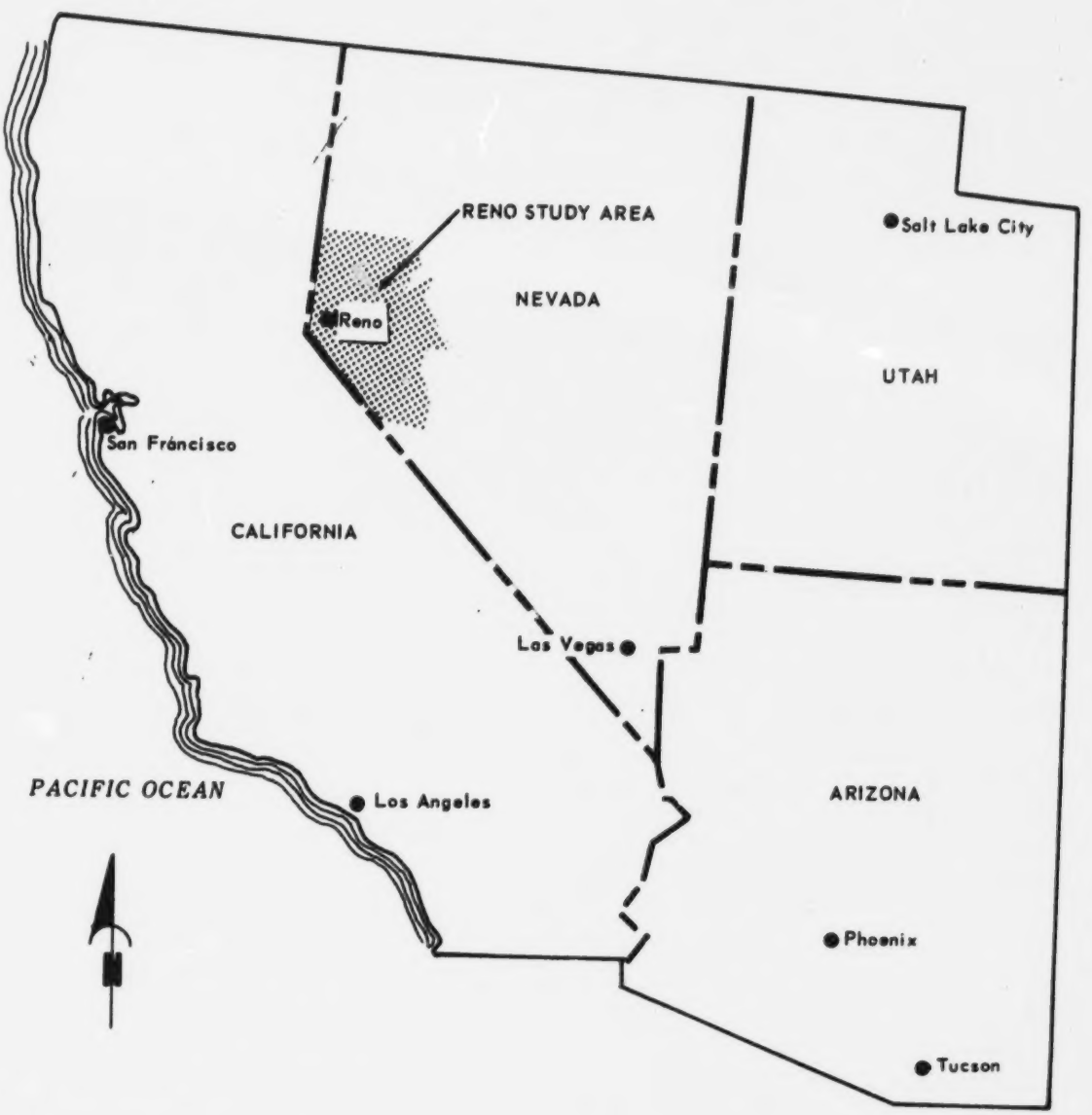

Figure 1. Map of Reno study area and surrounding cities.

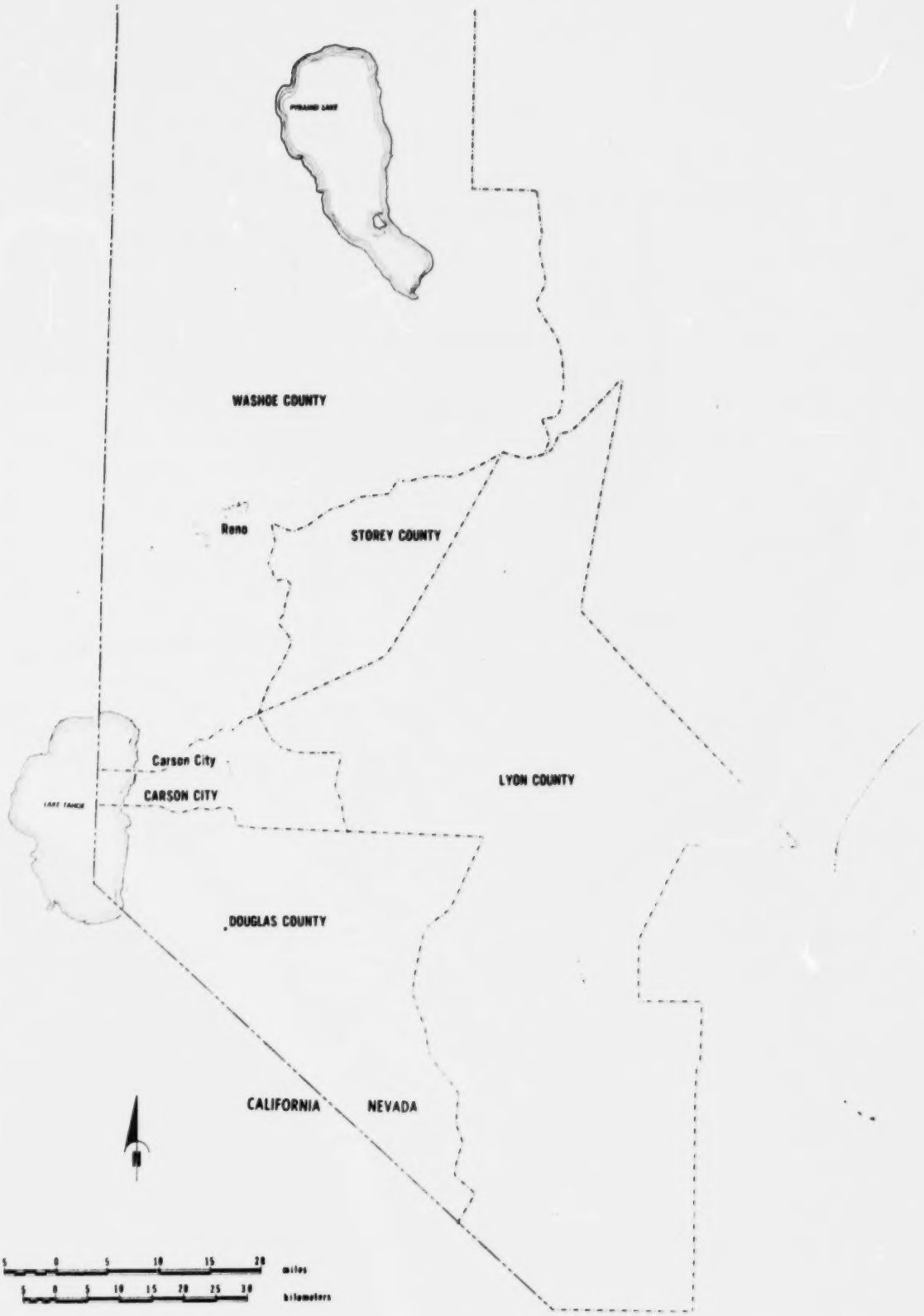

Figure 2 Detailed Map of the Reno Study Area

GRID COORDINATE SYSTEM

A grid coordinate system, based on the Universal Transverse Mercator Projection (UTM) was used in the Charlotte Study Area to show the geographical distribution of emissions. A map of this grid system is presented in Figure 3.

The UTM system was chosen due to its advantages over other standard grid systems such as the Latitude-Longitude and State Plane Coordinate Systems. The major advantages of this system are that (1) it is continuous across the country and is not hindered by political subdivisions, (2) the grids are of uniform size throughout the country, (3) it has world-wide use, and (4) the grids are square in shape--a necessary feature for use in meteorological dispersion models.

The Universal Transverse Mercator Projection is based upon the metric system. Each north-south and east-west grid line, as illustrated in Figure 3, is identified by a coordinate number expressed in meters. Each point source and grid is identified by the horizontal and vertical coordinates of their geographical center to the nearest 100 meters.

As shown in Figure 3, the Study Area was divided into 62 grids of three different sizes--25, 100, and 400 square kilometers. Grid zones of different sizes are used to limit the number of grid zones and yet allow a satisfactory definition of the geographical gradation of emissions. The majority of the emissions is usually concentrated in the populated and industrialized portions of a Study Area. Smaller grids are placed over these areas in order to reflect abrupt changes in emissions within short distances. The use of grid zones smaller than 25 square kilometers is not warranted because of the inherent inaccuracies in the data. Since only a small percentage of the total emissions occur in rural areas, larger grid zones are normally used to show the distribution of emissions in these lightly populated portions of a Study Area.

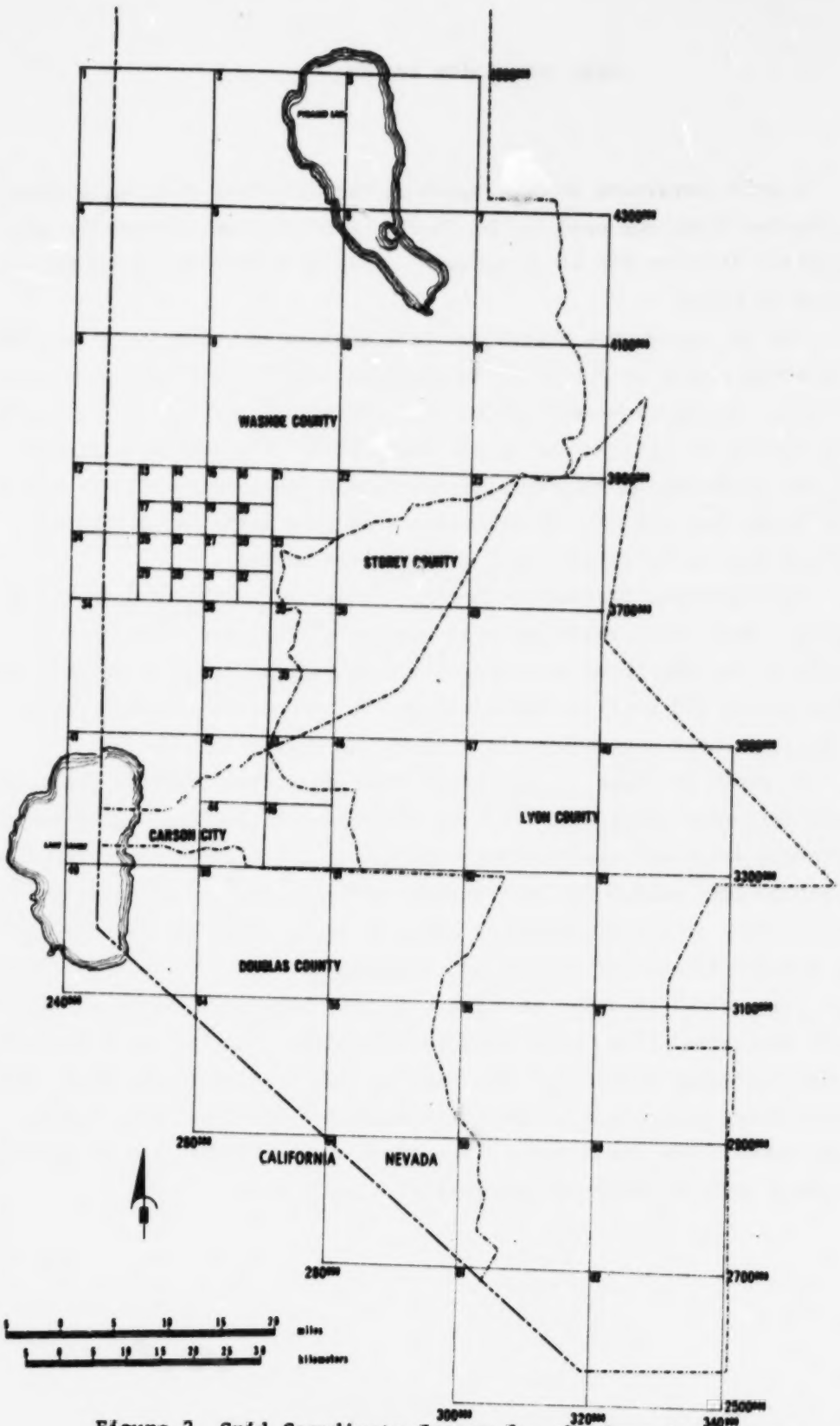

Figure 3 Grid Coordinate System for the Reno Study Area

EMISSIONS BY CATEGORY

For the purposes of compiling the basic data and emission estimates, the air pollutant sources were classified into the following five categories:

1. Stationary fuel combustion
2. Transportation
3. Solid waste disposal
4. Industrial processes
5. Evaporative losses

Each of these categories is considered individually in this section where data sources are given and methods of calculation discussed.

STATIONARY FUEL COMBUSTION

The stationary fuel combustion category is concerned with any fixed source which burns fuels for either space heating or process heating. The four primary sources in this category are industrial facilities, steam-electric plants, residential housing, and commercial and institutional establishments. In the Reno area, natural gas, liquified petroleum gas, distillate oil, and residual oil were the major fuels used. Table 3 presents a summary of the fuels consumed in the area and Table 4 the air pollutant emissions from the combustion of these fuels.

TRANSPORTATION

Three types of transportation sources of air pollution are considered in this survey--motor vehicles, aircraft, and railroads. Motor vehicles, which are by far the most significant source in this category, are further subdivided according to type of fuel--gasoline or diesel.

Motor Vehicles

More than 3.5 million miles per day were traveled by motor vehicles in 1969 in the Reno Study Area. In the process, 110 million gallons of

TABLE 3 FUEL CONSUMPTION IN THE RENO STUDY AREA, 1969

Fuel Jurisdiction	Steam-Electric	Industrial	Residential	Commercial-Institutional	Total
Natural Gas (Mill. CF)					
Carson City	--	--	200	650	
Douglas	--	--	170	1,400	
Lyon	6,600	870	30	130	
Storey	4,600	--	10	--	
Washoe	--	1,000	2,000	700	
Subtotal	11,200	1,870	2,410	2,730	
Distillate Fuel Oil (1000 Gal.)					
Carson City	--	--	2,500	100	
Douglas	--	--	110	100	
Lyon	--	--	1,100	50	
Storey	--	--	40	10	
Washoe	--	--	13,000	7,000	
Subtotal	--	--	16,750		
Residual Fuel Oil (1000 Gal.)					
Carson City	--	--	--	200	
Douglas	--	--	--	100	
Lyon	10	--	--	50	
Storey	20	--	--		
Washoe	--	1,000	--	6,500	
Subtotal	30	1,000	--	6,850	
LPG (1000 Gal.)					
Carson City	--	NA	1,000	NA	
Douglas	--	NA	1,100	30	
Lyon	--	NA	1,300	NA	
Storey	--	NA	50	NA	
Washoe	--	NA	2,400	NA	
Subtotal	--	NA	5,850	30	

TABLE 4 SUMMARY OF EMISSIONS FROM STATIONARY FUEL COMBUSTION SOURCES
1969 (Tons/Year)

Fuel User Category	Sulfur Oxides	Particulates	Carbon Monoxide	Hydrocarbons	Nitrogen Oxides
Natural					
Industrial	N	20	N	N	200
Steam-Electric	N	80	N	N	2,180
Residential	N	20	N	N	140
Commercial-Institutional	N	30	N	N	170
LPG					
Residential	N	N	N	N	120
Commercial-Institutional	N	N	N	N	N
Fuel Oil					
Industrial	140	10	--	--	40
Steam-Electric	N	N	N	N	N
Residential	560	70	20	30	100
Commercial-Institutional	1,190	130	10	10	510
TOTAL	1,890	360	30	40	3,460

N = Negligible

gasoline and 10 million gallons of diesel fuel were consumed for highway purposes for the year 1969. Table 5 shows the miles of travel for gasoline and diesel vehicles for each county in the Study Area. Emissions from motor vehicles and all other transportation sources are summarized in Table 6.

Aircraft

Table 7 shows the air traffic activity at the main airport in the Study Area. An estimate of the number of flights by engine type was supplied by the traffic controller at each airport and summarized in Table 7. The air pollutant emissions from aircraft include all phases of operation (taxi, take-off, climb out, approach and landing) that take place below the arbitrarily chosen altitude of 3,500 feet. Emissions at cruise altitude (above 3,500 feet) are not of concern in an emission inventory.

Railroads

Railroad operations (mainly locomotive) consume about 1.5 million gallons of diesel fuel per year within the Study Area. This quantity is about 85 percent less than the amount of diesel fuel consumed by motor vehicles. The majority of this fuel is consumed during switching operations. Diesel fuel consumption data were supplied by each of the major railroads in the Reno area.

SOLID WASTE DISPOSAL

Approximately 235,000 tons of refuse was generated during 1969 within the Study Area. Table 8 presents a solid waste balance for the Reno Study Area, showing the various methods of disposal and the quantities disposed of by each method. Table 9 summarizes the air pollutant emissions from this disposal of refuse.

TABLE 5 VEHICLE MILES OF TRAVEL FOR MOTOR VEHICLES IN THE RENO STUDY AREA, 1969 (Vehicle Miles/Day)

Jurisdiction	Gasoline Vehicle Miles	Diesel Vehicle Miles	Total
Douglas	230,000	32,000	262,000
Carson City	180,000	20,000	200,000
Lyon	185,000	30,000	215,000
Storey	170,000	2,000	172,000
Washoe	2,630,000	50,000	2,680,000
TOTAL	3,395,000	134,000	3,529,000

TABLE 6 AIR POLLUTANT EMISSIONS FROM TRANSPORTATION SOURCES, 1969

(Tons/Year)

Source Category	Sulfur Oxides	Particulates	Carbon Monoxide	Hydrocarbons	Nitrogen Oxides
Road Vehicles					
Gasoline	370	500	126,200	9,070	5,260
Diesel	190	540	290	660	1,090
Evaporative	--	--	--	5,200	--
Subtotal	560	1,040	126,490	14,930	6,350
Aircraft					
Jet	N	80	120	140	70
Piston	N	N	480	90	20
Subtotal	N	80	600	230	90
Railroads	30	90	50	100	170
GRAND TOTAL[a]	590	1,210	127,100	15,300	6,600

N = Negligible

a = Totals have been rounded.

TABLE 7 AIRPORT ACTIVITY AT THE MAJOR AIRPORT IN THE STUDY AREA
(Number of Flights for 1969)

Type Engine	Number of Flights
Conventional Jet	7,800
Fan Jet	11,000
Piston	5,900
TOTAL	24,700

TABLE 8 SOLID WASTE BALANCE FOR THE RENO STUDY AREA, 1969 (Tons/Year)

Jurisdiction	Total Refuse Generated	On-Site Incineration	Landfill or Non-Burning Dump	Dump	On-Site	Open Burning Auto Body	Agricultural
Carson City	22,500	2,200	18,300	N	2,000	NA	NA
Douglas	9,500	1,000	7,500	N	1,000	NA	NA
Lyon	12,000	1,200	9,000	N	1,800	NA	NA
Storey	1,000	100	700	N	200	NA	NA
Washoe	190,000	19,000	145,700	N	25,000	50	250
TOTAL	235,000	23,500	181,200	N	30,000	50	250

N = There are no dumps that burn as standard practice. Some of the non-burning dumps catch fire occassionally but the quantity of refuse disposed of by this burning is negligible.

NA = Information not available or not reported.

TABLE 9 AIR POLLUTANT EMISSIONS FROM SOLID WASTE DISPOSAL, 1969

(Tons/Year)

Source Category	Sulfur Oxides	Partic-ulates	Carbon Monoxide	Hydro-carbons	Nitrogen Oxides
Incineration					
Municipal	--	--	--	--	--
On-Site	20	120	520	10	40
Subtotal	20	120	520	10	40
Open Burning					
On-Site	30	160	760	80	60
Dump	N	N	10	N	N
Subtotal	30	160	770	80	60
GRAND TOTAL	50	280	1,290	90	100

N = Negligible

INDUSTRIAL PROCESS LOSSES

Emissions from industrial process losses are shown in Table 10. Particulate emissions from the mineral products industry are the only significant source of air pollution from this category.

EVAPORATIVE LOSSES

Three source categories were considered for evaporative losses--automobiles, gasoline storage and handling, and the consumption of solvents. The hydrocarbon emissions from all sources by evaporative losses are shown in Table 11.

Automobiles

Automobile evaporation losses include gas tank and carburetor evaporation and engine crankcase blowby. Since 1963, most new automobiles were equipped with positive crankcase ventilation (PCV) valves that reduce hydrocarbon emissions from the crankcase by about 90 percent. Due to a lag time in the automobile replacement rate, it was assumed that 20 percent of the automobiles were not equipped with PCV valves.

Gasoline Storage and Handling

There are four major points (excluding evaporation from the motor vehicle) of hydrocarbon emissions in the storage and handling of gasoline. There are:

1. Breathing and filling losses from storage tanks
2. Filling losses from loading tank conveyances
3. Filling losses from loading underground storage tanks at service stations.
4. Spillage and filling losses in filling automobile gas tanks at service stations.

Approximately 110 million gallons of gasoline and diesel fuel were stored in the Study Area in 1969. The evaporative losses from this

TABLE 10 PARTICULATE EMISSIONS FROM INDUSTRIAL PROCESSES

Type Industry	Emissions
Mineral Products	
Asphalt Batching	170
Cement	14,600
Diatamaceous Earth	3,740
Mining Operations	730
Rock Crushing	9,530
Sand and Gravel	4,840
TOTAL	33,610

TABLE 11 HYDROCARBON EMISSIONS FROM EVAPORATIVE LOSS SOURCES, 1969

(Tons/Year)

Source Category	Emissions
Gasoline Storage and Handling	1,610
Dry Cleaning	320
Automobile	5,200
Miscellaneous Solvent Consumption	410
TOTAL	7,540

storage and the subsequent handling accounted for 21 percent of the total evaporative losses.

Consumption of Solvents

This category included the consumption of solvents at dry cleaning plants, and the miscellaneous use of solvents by industries, small commercial establishments and domestic units. The consumption of solvents by these categories accounted for 5 percent of the hydrocarbon emissions from evaporative losses.

EMISSIONS BY JURISDICTION

The previous section presented the air pollutant emissions by source category. In order to show the contribution of each county to the pollution in the entire Study Area, their emissions are summarized in Tables 12 through 16.

TABLE 12 SUMMARY OF AIR POLLUTANT EMISSIONS IN CARSON CITY, 1969
(Tons/Year)

Source Category	Sulfur Oxides	Partic-ulates	Carbon Monoxide	Hydro-carbons	Nitrogen Oxides
Transportation					
Road Vehicles	50	100	6,000	540	440
Other	N	N	N	N	--
Subtotal	50	100	6,000	540	440
Stationary Fuel Combustion					
Industry	N	N	N	N	N
Steam-Electric	N	N	N	N	N
Residential	80	10	N	N	30
Commercial and Institutional	30	10	N	N	50
Subtotal	110	20	N	N	80
Refuse Disposal					
Incineration	N	10	50	N	N
Open Burning	N	20	80	30	10
Subtotal	N	30	130	30	10
Process	--	910	N	N	--
Evaporative Losses	--	--	--	430	--
GRAND TOTAL	160	1,060	6,130	1,000	530

a = Evaporative losses from motor vehicles included only under evaporative losses.

TABLE 13 - SUMMARY OF AIR POLLUTANT EMISSIONS IN DOUGLAS COUNTY, 1969

(Tons/Year)

Source Category	Sulfur Oxides	Particulates	Carbon Monoxide	Hydrocarbons	Nitrogen Oxides
Transportation					
Road Vehicles	70	160	6,130	620	610
Other	N	N	N	N	N
Subtotal	70	160	6,130	620	610
Stationary Fuel Combustion					
Industry	N	N	N	N	N
Steam-Electric	--	--	--	--	--
Residential	N	N	N	N	10
Commercial and Institutional	20	20	N	N	90
Subtotal	20	20	N	N	100
Refuse Disposal					
Incineration	N	N	20	N	N
Open Burning	N	10	40	10	N
Subtotal	N	10	60	10	N
Industrial Process	--	730	--	--	--
Evaporative Losses[a]	--	--	--	500	--
GRAND TOTAL	90	920	6,190	1,130	710

a = Evaporative losses from motor vehicles included only under evaporative losses.

TABLE 14 SUMMARY OF AIR POLLUTANT EMISSIONS IN LYON COUNTY, 1969

(Tons/Year)

Source Category	Sulfur Oxides	Partic-ulates	Carbon Monoxide	Hydro-carbons	Nitrogen Oxides
Transportation					
Road Vehicles	60	150	4,930	520	520
Other	N	N	N	N	N
Subtotal	60	150	4,930	520	520
Stationary Fuel Combustion					
Industry	N	10	N	N	90
Steam-Electric	N	50	N	N	1,290
Residential	40	N	N	N	10
Commercial and Institutional	10	N	N	N	10
Subtotal	50	60	N	N	1,400
Refuse Disposal					
Incineration	N	10	30		N
Open Burning	N	10	80	30	10
Subtotal	N	20	110	30	10
Industrial Process	--	23,670	--	--	--
Evaporative Losses	--	--	--	410	--
GRAND TOTAL	110	23,900	5,120	960	1,930

a = Evaporative losses from motor vehicles included only under evaporative losses.

TABLE 15 SUMMARY OF AIR POLLUTANT EMISSIONS IN STOREY COUNTY, 1969

(Tons/Year)

Source Category	Sulfur Oxides	Particulates	Carbon Monoxide	Hydrocarbons[a]	Nitrogen Oxides
Transportation					
Road Vehicles	20	30	5,130	400	280
Other	N	N	N	N	N
Subtotal	20	30	5,130	400	280
Stationary Fuel Combustion					
Industry	N	N	N	N	N
Steam-Electric	N	30	N	N	900
Residential	N	N	N	N	N
Commercial and Institutional	N	N	N	N	N
Subtotal	N	30	N	N	900
Refuse Disposal					
Incineration	N	N	N		N
Open Burning	N	N	10		N
Subtotal	N	N	10	N	N
Industrial Process	--	--	--	--	--
Evaporative Losses	--	--	--	320	--
GRAND TOTAL	20	60	5,140	720	1,180

a = Evaporative losses from motor vehicles included only under evaporative losses.

TABLE 16 SUMMARY OF AIR POLLUTANT EMISSIONS IN WASHOE COUNTY, 1969

(Tons/Year)

Source Category	Sulfur Oxides	Particulates	Carbon Monoxide	Hydrocarbons [a]	Nitrogen Oxides
Transportation					
Road Vehicles	360	590	104,330	7,650	4,500
Other	30	160	650	330	260
Subtotal	390	750	104,980	7,980	4,760
Stationary Fuel Combustion					
Industry	140	20	N	N	140
Steam-Electric	--	--	--	--	--
Residential	440	70	10	20	200
Commercial-Institutional	1,130	130	10	10	530
Subtotal	1,710	220	20	30	870
Refuse Disposal					
Incineration	20	100	420	10	30
Open Burning	30	130	560	10	40
Subtotal	50	230	980	20	70
Industrial Process	--	8,300	--	--	--
Evaporative Losses	--	--	--	5,880	--
GRAND TOTAL	2,150	9,500	105,980	13,910	5,700

a = Evaporative losses from motor vehicles included only under evaporative losses.

EMISSIONS BY GRID

For the purpose of defining the geographical variation of air pollutant emissions in the Study Area, the resulting emissions were apportioned on the grid coordinate system. The emissions were divided into two source groups--point and area sources. Fifteen point sources are identified individually with respect to location and emissions. Each of these point sources emitted more than 50 tons per year of any pollutant.

Table 17 presents the emissions of the fifteen point sources in the area. Each source is identified by source category, grid number and horizontal and vertical coordinates. The emissions of sulfur oxides, particulates, carbon monoxide, hydrocarbons, and nitrogen oxides are shown for an average summer day (June, July, August), an average winter day (December, January February) and an average annual day. The appendix presents the method of calculating these three averages.

Area sources are sources of emissions that are significant by themselves, but as a group may emit a large portion of the areas total pollution. Examples of area sources are motor vehicles, residences, light commercial and industrial establishments and backyard burning. The emissions from area sources have been added to that for point sources to obtain total emissions from all sources by grid, as shown in Table 18. The emissions from all sources are also shown for an annual average, winter and summer day.

TABLE 17

SUMMARY OF AIR POLLUTANT EMISSIONS FROM POINT SOURCES
TONS/DAY

ID	GR	HC	VC	SOX			PART			CO			HC			NOX		
				S	W	A	S	W	A	S	W	A	S	W	A	S	W	A
2	20	2666	43814	0.0	0.0	0.0	7.39	7.39	7.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	22	2980	43830	0.0	0.0	0.0	0.11	0.07	0.09	0.00	0.00	0.00	0.00	0.00	0.00	2.95	1.90	2.35
4	22	2990	43840	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.11	0.10
2	23	3045	43890	0.0	0.0	0.0	40.01	40.02	40.01	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.25	0.22
2	23	3070	43870	0.0	0.0	0.0	0.24	0.24	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	24	2450	43790	0.0	0.0	0.0	0.41	0.41	0.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	24	2450	43780	0.0	0.0	0.0	10.00	10.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	27	2614	43782	0.0	0.0	0.0	4.92	4.93	4.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.01
2	27	2649	43793	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	1.55	1.55	1.55	0.00	0.00	0.00
7	27	2619	43752	0.0	0.0	0.0	0.21	0.21	0.21	1.65	1.65	1.65	0.62	0.62	0.62	0.24	0.24	0.24
2	45	2672	43374	0.0	0.0	0.0	1.50	1.50	1.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	45	2665	43379	0.0	0.0	0.0	0.93	0.93	0.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	51	2970	43270	0.0	0.0	0.0	2.00	2.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	52	3090	43120	0.0	0.0	0.0	24.60	24.60	24.60	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.03	0.02
4	52	3140	43220	0.0	0.0	0.0	0.15	0.09	0.13	0.00	0.00	0.00	0.00	0.00	0.00	4.14	2.57	3.32

TABLE 18 SUMMARY OF AIR POLLUTANT EMISSIONS FROM ALL SOURCES
TONS/DAY

GRID	AREA	SOX			PART			CO			HC			NOX		
		S	W	A	S	W	A	S	W	A	S	W	A	S	W	A
1	154.4	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.8	0.9	0.2	0.1	0.1	0.1	0.1	0.1
2	154.4	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.1	0.0	0.1	0.0	0.0	0.0
3	154.4	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0
4	154.4	0.0	0.1	0.1	0.1	0.1	0.1	3.7	3.1	3.4	0.6	0.5	0.6	0.3	0.2	0.2
5	154.4	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.8	0.9	0.1	0.1	0.1	0.1	0.1	0.1
6	154.4	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.6	0.7	0.1	0.1	0.1	0.1	0.0	0.0
7	154.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	154.4	0.0	0.0	0.0	0.0	0.0	0.0	2.8	2.3	2.6	0.4	0.3	0.4	0.2	0.2	0.2
9	154.4	0.0	0.0	0.0	0.0	0.0	0.0	2.0	1.6	1.8	0.3	0.3	0.3	0.1	0.1	0.1
10	154.4	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
11	154.4	0.0	0.0	0.0	0.1	0.1	0.1	2.4	1.9	2.1	0.4	0.3	0.3	0.2	0.2	0.2
12	38.6	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.8	0.9	0.2	0.1	0.2	0.1	0.1	0.1
13	9.6	0.0	0.1	0.1	0.1	0.1	0.1	7.1	5.8	6.5	1.0	0.9	0.9	0.4	0.4	0.4
14	9.6	0.0	0.1	0.0	0.1	0.0	0.1	5.0	4.1	4.6	0.7	0.6	0.6	0.3	0.3	0.3
15	9.6	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.5	0.5	0.1	0.1	0.1	0.0	0.0	0.0
16	9.6	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.7	0.8	0.1	0.1	0.1	0.0	0.0	0.0
17	9.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	9.6	0.1	0.6	0.4	0.2	0.2	0.2	14.9	12.2	13.6	2.0	1.7	1.8	0.8	0.9	0.9
19	9.6	0.1	1.0	0.6	0.2	0.3	0.3	30.4	24.9	27.7	3.5	3.0	3.2	1.2	1.4	1.3
20	9.6	0.0	0.0	0.0	7.4	7.4	7.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	38.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	154.4	0.0	0.0	0.0	0.1	0.1	0.1	1.8	1.5	1.6	0.3	0.2	0.2	3.2	2.1	2.6
23	154.4	0.1	0.1	0.1	40.4	40.4	40.4	7.8	6.4	7.1	1.2	1.0	1.1	0.9	0.8	0.9
24	38.6	0.0	0.1	0.0	10.5	10.4	10.4	3.9	3.2	3.5	0.6	0.5	0.5	0.3	0.2	0.3

TABLE 18 (Cont.)

25	9.6	0.0	0.1	0.1	0.1	0.1	0.1	6.8	5.6	6.2	1.0	0.8	0.9	0.4	0.4	0.4
26	9.6	0.7	5.4	3.2	1.1	1.6	1.4	130.7	107.2	119.0	15.5	13.1	14.3	5.4	6.8	6.2
27	9.6	0.3	1.8	1.1	5.6	5.7	5.7	62.8	51.7	57.2	9.0	7.9	8.5	2.7	3.0	2.9
28	9.6	0.0	0.0	0.0	0.0	0.0	0.0	3.3	2.7	3.0	0.4	0.3	0.3	0.2	0.1	0.1
29	9.6	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.9	1.0	0.2	0.1	0.2	0.1	0.1	0.1
30	9.6	0.0	0.2	0.1	0.1	0.1	0.1	6.4	5.2	5.8	0.8	0.7	0.7	0.3	0.3	0.3
31	9.6	0.0	0.1	0.1	0.0	0.1	0.1	6.7	5.5	6.1	0.8	0.7	0.8	0.3	0.3	0.3
32	9.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	38.6	0.0	0.0	0.0	0.0	0.0	0.0	4.4	3.6	4.0	0.6	0.5	0.6	0.3	0.2	0.2
34	154.4	0.1	0.0	0.1	0.1	0.1	0.1	10.5	8.6	9.6	1.5	1.2	1.3	0.7	0.6	0.6
35	38.6	0.0	0.0	0.0	0.1	0.0	0.1	6.7	5.5	6.1	0.9	0.8	0.9	0.4	0.4	0.4
36	38.6	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.6	0.6	0.1	0.1	0.1	0.0	0.0	0.0
37	38.6	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.3	0.4	0.1	0.0	0.1	0.0	0.0	0.0
38	38.6	0.0	0.0	0.0	0.1	0.1	0.1	12.1	9.9	11.0	1.7	1.4	1.5	0.7	0.5	0.6
39	154.4	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.6	0.6	0.1	0.1	0.1	0.1	0.1	0.1
40	154.4	0.0	0.0	0.0	0.0	0.0	0.0	1.4	1.1	1.2	0.2	0.2	0.2	0.1	0.1	0.1
41	154.4	0.1	0.1	0.1	0.1	0.1	0.1	5.7	4.6	5.1	0.9	0.8	0.8	0.5	0.4	0.5
42	38.6	0.0	0.1	0.1	0.1	0.1	0.1	3.7	3.1	3.4	0.7	0.5	0.6	0.3	0.3	0.3
43	38.6	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.8	0.9	0.2	0.2	0.2	0.1	0.1	0.1
44	38.6	0.1	0.5	0.3	0.3	0.4	0.3	12.0	9.9	10.9	1.9	1.6	1.7	0.9	1.3	1.1
45	38.6	0.0	0.0	0.0	2.5	2.5	2.5	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
46	154.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	154.4	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.6	0.7	0.2	0.1	0.1	0.1	0.1	0.1
48	154.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	154.4	0.1	0.1	0.1	0.2	0.3	0.3	9.3	7.6	8.5	1.6	1.3	1.5	0.9	1.6	1.3
50	154.4	0.0	0.1	0.1	0.1	0.1	0.1	2.7	2.3	2.5	0.6	0.5	0.5	0.3	0.3	0.3
51	154.4	0.0	0.0	0.0	2.0	2.0	2.0	0.3	0.2	0.2	0.1	0.1	0.1	0.0	0.0	0.0
52	154.4	0.0	0.2	0.1	24.9	24.8	24.9	2.9	2.4	2.6	0.7	0.6	0.6	4.5	3.0	3.9
53	154.4	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.4	0.4	0.1	0.1	0.1	0.1	0.0	0.0

TABLE 18 (Cont.)

54	154.4	0.0	0.0	0.0	0.1	0.1	0.1	3.4	2.8	3.1	0.6	0.5	0.6	0.4	0.3	0.3
55	154.4	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.8	0.8	0.2	0.2	0.2	0.1	0.1	0.1
56	154.4	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.4	0.5	0.1	0.1	0.1	0.1	0.0	0.1
57	154.4	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
58	154.4	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.2	0.2	0.1	0.1	0.1	0.0	0.0	0.0
59	154.4	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
60	154.4	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
61	154.4	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
62	154.4	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL		5.3	14.5	10.2	96.7	97.3	97.3	389.6	320.5	355.1	55.6	47.7	51.7	31.3	30.9	31.4

REFERENCES

1. Ozolins, Guntis and Raymond Smith, Rapid Survey Techniques for Estimating Community Air Pollution Emissions. DHEW, PHS, October 1966.

2. Duprey, R.L., Compilation of Air Pollutant Emission Factors, United States, DHEW, PHS, 1968.

APPENDIX A

METHOD FOR CALCULATING SUMMER, WINTER AND ANNUAL AVERAGE EMISSIONS FOR FUEL CONSUMPTION IN STATIONARY SOURCES

YEARLY AVERAGE (A)

$$A = \frac{\text{Fuel Consumed} \times \text{Emission Factor (E. F.)}}{\text{Days of Operation}}$$

e.g. A plant consumed 100,000 tons of coal in 1967 while operating 365 days. The total degree days for the area was 4,800 and 2,800 for the three winter months. The plant was estimated to use 15 percent of the fuel for space heating and 85 percent for process heating. From this information, the annual average emission for carbon monoxide would be the following:

$$A = \frac{100{,}000 \text{ Tons/year} \times 3 \text{ lbs. CO/Ton coal}}{365 \text{ Days/year} \times 2{,}000 \text{ lb./Ton}}$$

$$A = 0.41 \text{ Ton/Day}$$

WINTER AVERAGE (W)

$$W = \frac{\text{Fuel Consumed} \times \text{E.F.}}{\text{Days of Winter Operation}} \times \frac{\text{Winter Degree Days}}{\text{Total Degree Days}} \times \text{\% Fuel Used for space heating}$$

$$+ \frac{\text{Fuel Consumed} \times \text{E.F.}}{365} \times \text{\% Fuel used for process heating}$$

$$W = \left[\frac{100{,}000 \times 2{,}800}{90 \times 4{,}800} \times 0.15 + \frac{100{,}000}{365} \times 0.85\right] \frac{3}{2{,}000}$$

$$W = 0.49 \text{ Ton/Day}$$

SUMMER AVERAGE (S)

$$S = \frac{\text{Fuel Consumed} \times \text{E.F.}}{\text{Days of Summer Operation}} \times \frac{\text{Summer Degree Days}}{\text{Total Degree Days}} \times \text{\% Fuel Used for space heating}$$

$$+ \frac{\text{Fuel Consumed} \times \text{E.F.}}{365} \times \text{\% Fuel used for process heating}$$

$$S = \left[\frac{100{,}000}{90} \times \frac{0}{4{,}800} \times 0.15 + \frac{100{,}000}{365} \times 0.85\right] \frac{3}{2{,}000}$$

$$S = 0.35 \text{ Ton/Day}$$

APPENDIX B
METRIC CONVERSION FACTORS

Multiply	By	To Obtain
Feet	0.3048	Meters
Miles	1609	Meters
Square Feet	0.0929	Square meters
Square Miles	2.59	Square kilometers
Pounds	453.6	Grams
Pounds	$453.6/10^4$	Tons (metric)
Tons (metric)	1.103	Tons (short)
Tons (short)	907.2	Kilograms
Tons (short)	.9072	Tons (metric)

To Obtain	By	Divide